

# Proceedings of 10th International Workshop on Laser Ranging Instrumentation

第十屆國際激光測距會議論文集

Compiled and Edited by  
Yang Fumin, Chen Wanzhen

Shanghai Observatory , Chinese Academy of Sciences  
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**TABLE OF CONTENTS**

	<u>Page No.</u>
<b>Forward</b> .....	viii
<b>Workshop Agenda</b> .....	ix
<b>List of Participants</b> .....	xvii
<b>Scientific Achievements and Applications--Richard Eanes</b> .....	1
<i>The Science Derived from Lunar Laser Ranging,</i> Peter J. Shelus .....	2
<i>Applications of Accurate SLR Station Positioning</i> Peter Dunn .....	10
<i>Quality Checks within the EUROLAS Cluster</i> G.M.Appleby .....	19
<i>Compact Laser Transponders for Interplanetary Ranging and Time Transfer</i> John J. Degnan .....	24
<i>A Wide Angle Airborne or Spaceborne Laser Ranging Instrumentation for Millimeter</i> <i>Accuracy Subsidence Measurements</i> O.Bock, M. Kasser, Ch. Thom .....	32
<i>Proposition for a New SLR Methodology Using CW or Long Pulse Lasers</i> M.Kasser, C.Thom .....	43
<b>Laser Ranging Performance Evaluation Session--Michael Pearlman</b> .....	51
<i>Global SLR Performance Evaluation</i> Van S. Husson .....	52
<i>SLR Data Usage, Applications, Performance and Requirements</i> Michael Pearlman .....	61
<i>Station Performance Evaluation Borowiec SLR (7811)</i> S. Schillak .....	66
<i>Global SLR: Recognition, Identification, and Resolution of Data Problems.</i> Tom Varghese .....	68
<b>New Fixed Stations--Hiroo Kunimori</b> .....	77
<i>The New Laser and Astrometric Telescope in Zimmerwald</i> W.Gurtner, E.Pop, T.Schildknecht, J.Utzinger, U.Wild, J.Barbe .....	78
<i>The Current Status and Development of Changchun SLR System</i> Liu Zhi, Fan Cunbo, Chen Haiyan, Zhang Xinghua, Liu Chengzhi, Shi Jianyong, Li Yinzhu, Gong Yan, Jin Honglin, Zhao You .....	90
<i>Matera Laser Ranging Observatory Software System</i> Matthew Bieneman, C. Bart Clarke, J. Michael Heinick, David McClure, Bhashyam,	

Nallappa, Michael Selden, Giuseppe Bianco .....	93
<i>Upgrading the SLR station Katziveli</i>	
Yu.V.Ignatenko, Yu.L.Kokurin, V.V.Kurbasov, V.F.Lobanov, A.N.Sukhanovski, V.N.Triapitsin .....	102
<i>Status Report on Borowiec SLR, 1994-1996</i>	
S.Schillak, J.Bartoszak, E.Butkiewicz, D.Schillak, S.Zapasnik .....	104
<i>The Laser Ranging System of Yunnan Observatory (YLRS) and its Status</i>	
Jiang Chongguo, Xiong Yaoheng, Wang Wu, Feng Hesheng .....	110
<i>The Simeiz (N 1873) SLR Station</i>	
L.S.Stirberg, S.K.Tatevian .....	115
<b>New Mobile Stations---Ulrich Schreiber .....</b>	<b>119</b>
<i>Report on Saudi Arabian Laser Ranging Observatory(SALRO)</i>	
Attieh A Al- Ghamdi .....	120
<i>TIGO-Project : Concept-Status-Plans</i>	
P.Sperber, A.Boeer, R.Dassing, H.Hase, W.Schlueter, R.Kilger .....	135
<i>TIGO SLR Modul: Status</i>	
P.Sperber, A.Boeer, R.Dassing, U.Hessels, W.Schlueter .....	145
<i>A Transportable Laser Ranging System in China (CTLRS)</i>	
Xia Zhizhong, Cai Qingfu, Ye Wenwei Guo Tangyong, Wang Linhua .....	160
<b>Lunar Laser Ranging---Peter Shelus .....</b>	<b>167</b>
<i>Adaptive Ridge Regression: the Multicollinearity and its Remedy- a Case in Lunar Laser Ranging</i> Chengli HUANG , Wenjing JIN, Huaguan XU .....	168
<i>Expected Results from the Analysis of LLR Data</i>	
J.Mueller, U. Schreiber .....	178
<i>The Impact of Technology on Lunar Laser Ranging at MLRS</i>	
Peter J. Shelus .....	183
<i>The Lunar Laser Ranging Network and the Lunar Data Gathered ...Are they Sufficient?</i>	
Peter J. Shelus .....	185
<i>Millimetric Lunar Laser Ranging O.C.A/C.E.R.G.A.</i>	
J.F.Mangin, J.E.Chabaudie, D.Feraudy, P.Fridelance, M.Furia, M.Glantzlin, A.Journet, J.Pharm Van, E.Samain, J.M.Torre, G.Vigouroux .....	189
<i>Prospects for LLR at Orroral</i>	
J.Mck. Luck .....	194
<i>Compensation of Laser Beam Propagation for the LLR</i>	
Feng Hesheng , Xiong Yaoheng .....	196
<b>Target Design, Signature and Biases---Andrew Sinclair .....</b>	<b>201</b>
<i>Amplitude Corrections to Delay Measurements</i>	
John Luck, Tom Stamp, Mark Elphick, Suzanne Jackson .....	202
<i>Accuracy of the Satellite Laser Ranging</i>	
S.Schillak .....	208
<i>Preliminary Design of the Laser Reflector Array for the CHAMP Satellite</i>	
Reinhart Neubert .....	216
<i>Dependence of Ajisai's Center-of-Mass Correction on Laser Ranging System</i>	
Toshimichi Otsubo, Jun Amagai, Hiroo Kunimori .....	223
<i>Remote Sensing of Atmospheric Parameters</i>	
Ulrich Schreiber, Birgit Bardorf, Stefan Riepl, Karl Heinz Haufe .....	233
<i>On-Orbit Measurement of TOPEX Impulse Response: Assessment of Coherent Interaction and Verification of Range Correction</i> Thomas Varghese, Thomas W. Zagwodzki,	

Jan F.McGarry, John J.Degnan, Brion Conklin .....	242
<i>Refined mathematical model of satellite WPLTN-1-fizeau</i>	
V.Burmistrov, V.Shargorodsky, V.Vassiliev , N.Soyuzova .....	251
<i>Study of retroreflectors with two-spot reflection pattern at sloped light incidence</i>	
V.Burmistrov, V.Shargorodsky, V.Vassiliev, N.Soyuzova .....	259
<i>The Polarization Behavior of Cube Corner Retroreflectors Used in SLR Satellites</i>	
M.Kasser, B.Goupil .....	263
<i>Eurolas Cluster Stations Bias Workshop Results</i>	
G. Kirchner, F. Koidl .....	269
<b>Detectors and Spectral Filters---Georg Kirchner .....</b>	<b>275</b>
<i>The Performance Test of F4129f MCP-PMT in Changchun Station</i>	
Liu Zhi, Zhao You, Zhang Xinghua, Fan Cunbo .....	276
<i>Increasing System Sensitivity at Lure Observatory or How to Get GPS Data with a 400 mm</i>	
<i>(16 inch) Aperture Telescope</i> R. Zane, M. T. Maberry, D.J.O'Gara .....	279
<i>SPAD Detectors for Ranging with Sub-Millimeter Bias</i>	
I.Prochazka, K.Hamal .....	287
<i>Automatic SPAD Time Walk Compensation</i>	
G.Kirchner, F. Koidl .....	293
<i>Large-aperture Germanium Detector Package for Picosecond Photon Counting in the 0.5-</i>	
<i>1.6-<math>\mu</math>m Range</i> I.Prochazka, K. Hamal, B. Greene, H. Kunimori .....	297
<i>Testing Ge-APS's for Ranging Applications in a Cryogenic Environment</i>	
Ulrich Schreiber, Christian Schoetz, Karl Heinz Haufe .....	301
<i>Effects of Common Gating Schemes on SPAD/APD Bias</i>	
Suzanne Jackson .....	312
<b>Laser Technology Development---Karel Hamal .....</b>	<b>319</b>
<i>Cr:LiSAF/Ti:Sapphire Based Solid State Laser System for Two Color Satellite Laser</i>	
<i>Ranging</i> Peter Sperber, Armin Boer, Eugen Pop, Frederic Estable, Luc Vigroux,	
Franck Falcoz .....	320
<i>Optimal Design of Passively Q-Switched Microlaser Transmitters for Satellite Laser</i>	
<i>Ranging</i> John J. Degnan .....	334
<i>Eye Safe Raman laser</i>	
K.Hamal, J.Blazej, I.Prochazka .....	344
<i>A Compact Modified SFUR Passively Mode-locked Nd:YAG Laser for Satellite Ranging</i>	
Sun Zhan'ao, Yang Xiangchun, Zhu Xiaolei , Wu Zhaoqing, Yang Fumin, Chen	
Wanzhen, Xiao Chikun .....	349
<i>kHz Laser for Satellite Ranging</i>	
Yue Gao, Ben Greene, Yanjie Wang .....	352
<b>Eyesafe Systems---Ivan Prochazka .....</b>	<b>359</b>
<i>Integration of the SLR Radar into the Geophysical Laboratory</i>	
H.Donovan, T.Varghese, R.Allshouse, D.Patterson, R.Suvall, J.Miller, J.Degnan .....	360
<i>SLR2000: An Inexpensive, Fully Automated, Eyesafe Satellite Laser Ranging System</i>	
John Degnan, Jan McGarry, Thomas Zagwodzki, Paul Titterton, Harold Sweeney,	
Howard Donovan, Michael Perry, Brion Conklin, Winfield Decker, Jack Cheek,	
Anthony Mallama, Peter Dunn, Randall Ricklefs .....	367
<i>Correlation Processing Approach for Eyesafe SLR 2000</i>	
Paul J.Titterton, Harold E. Sweeney .....	378
<i>SLR2000 Performance Simulations</i>	
J.McGarry .....	385

<i>Centimeter Eyesafe Satellite Laser Ranging Using Raman Shifted Nd:YAG Laser and Germanium Photon Counter</i> B.Greene, H.Kunimori, K.Hamal, I.Prochazka .....	392
<b>Timing Devices and Calibration---John Luck</b> .....	403
<i>Instrumentation Development and Calibration for the Matera Laser Ranging Observatory</i> Charles Steggerda, C.Bart Clarke, J.Michael Heinick, David McClure, Michael Selden, Ray Stringfellow, Giuseppe Bianco .....	404
<i>MultiCounter Operation at SLR Graz</i> G.Kirchner, F.Koidl .....	414
<i>Femtosecond Timing of Electronic Pulses for SLR</i> Ben Greene, Leigh Dahl, Josef Koelbl .....	419
<i>WLRS Timing System Aspects</i> Ulrich Schreiber, Karl Heinz Haufe, Nikolaus Brandl, Reiner Dassing, Guenther Herold, Guenther Pochert, Dieter Feil .....	426
<i>Short Distance Calibration</i> G.Kirchner, F.Koidl .....	431
<i>Portable SLR Calibration Standard</i> I.Prochazka, K.Hamal, H.Kunimori, B.Greene .....	436
<i>Calibration Setup for Helwan Station Two Detectors Comparison Experiment</i> M.Tawadros, I.Prochazka, M.Cech, K.Hamal, H.Jelinkova, A.Novotny .....	442
<b>Multiwavelength Ranging/Streak Cameras---Jean Gaignebet</b> .....	445
<i>Streak Camera and Two Color Laser Ranging</i> Jean Gaignebet, Jean-Louis Hatat, Jean-Louis Oneto .....	446
<i>The Circular Streak Camera Experiment of the WLRS</i> Stefan Riepl, Ulrich Schreiber, Wolfgang Schlueter .....	451
<i>Water Vapour Correction of Two-Color SLR</i> Reinhart Neubert .....	471
<i>Atmospheric Dispersion Monitoring Using 0.53 <math>\mu</math>m and 1.54 <math>\mu</math>m Satellite Laser Ranging</i> B.Greene, H.Kunimori, K.Hamal, I.Prochazka .....	477
<i>Second Harmonic Based T/R Switch</i> K.Hamal, B.Greene .....	479
<b>System Automation and Operational Software---Jan McGarry</b> .....	481
<i>An Assessment of the IRV model for the GPS satellites</i> A.T. Sinclair .....	482
<i>The GFZ/D-PAF orbit Prediction System with Emphasis on the Low Flyer GFZ-1</i> Z. Chen., R.Koenig .....	489
<i>Matera Laser Ranging Observatory System</i> Michael Selden, Giuseppe Bianco .....	498
<i>X Window Based Graphical User Interface for a Laser Ranging Control System</i> Jacek W. Offierski, Marcel J. Heijink .....	504
<i>Real-Time Correction of SLR Range Measurements for the Return Amplitude Induced Bias of the Multi-Channel Plate PMT/TC-454 DSD Discriminator Receive System</i> D.J.O'Gara, R.Zane, M.T.Maberry .....	511
<i>Combined Digital Tracking System</i> K.Hamal, I.Prochazka .....	514
<i>Automation of the Borowiec SLR</i> S. Schillak, J.Bartoszak, E.Butkiewicz .....	522
<i>Upgrading the NASA Satellite Laser Ranging Network for the 21st Century and the Single Operator Automation Project</i>	

John Bosworth, David Carter, John Degnan, Jan McGarry, Winfeld Decker .....	529
<i>Automated Quality Control of NASA SLR Data</i>	
Van S. Husson .....	533
<i>Automated and Remotely Operated SLR Systems</i>	
Christopher Moore, Jeff Cotter, Iztok Fras, Ben Greene, Adrian Loeff, Tim May .....	538
<i>A method to improve the accuracy of low orbit satellite prediction</i>	
Lin Qinchang, Yang Fumin, Tan Detong, Tang Wenfang, Zhang Zhongping, Deng Youjun .....	545
<i>RGO Predictions and Time Bias Functions</i>	
Roger Wood .....	550
<i>Automatic Ranging Software in Graz</i>	
G.Kirchner, F.Koidl .....	554
<b>Data Analysis and Models---Vincenza Luceri .....</b>	<b>559</b>
<i>Analysis of HTLRS Data at Marine Fiducial Points in Japan</i>	
Masayuki Fujita, Arata Sengoku .....	560
<i>New Mapping Function of the Tropospheric Refraction in SLR</i>	
Haojian YAN, Chugang FENG .....	567
<i>The Question of SLR Measuring Error Distribution</i>	
Wu Jie, Li Zhengxin, Zhang Zhongping, Yang Fumin, Tan Detong .....	575
<i>Full-rate vs. Normal Points: Two Ways of Managing SLR Data</i>	
R.Devoti, M.Fermi, V.Luceri, P.Rutigliano, C.Sciarretta, G. Bianco .....	582
<i>Fast Computing the Spherical Harmonic Perturbation on Artificial Satellite and the Recurrence Relations of the Coefficients of the Earth's Gravity</i>	
Lin Qinchang, Lin Yuan .....	587
<i>Work Organization and Some Results of the Data Analysis on Satellite Laser Ranging at Russian Mission Control Center</i>	
V.D.Glotov, V.V.Mitrikas, V.S.Poliakov, V.N.Pochukaev .....	593
<i>Discussion over Orbit Determination of Satellite Ajisai</i>	
Jiang Hu, Feng Chugang .....	600
<b>Late Papers .....</b>	<b>605</b>
<i>Keystone SLR System</i>	
H.Kunimori, C.Miki, J.Amagai, H.Nojiri, T.Otsubo, B.Greene, H.Izuha .....	606
<i>Preliminary Report on ADEOS/RIS Laser Tracking Experiments</i>	
H.Kunimori, T.Gotoh, H.Nojiri, M.Sawabe, M.Ogawa, and M.Maeda .....	614
<i>Synchronous Satellite Laser Ranging for Millimeter Baselines</i>	
T.Herring, H.Kunimori, B.Greene .....	621
<b>Session Summaries and Resolutions .....</b>	<b>627</b>

# Forward

The Tenth International Workshop on Laser Ranging Instrumentation was successfully held in the Convention Center, Chinese Academy of Sciences in Shanghai, China on November 11-15, 1996. This was the first time for the Workshop to be held in Asia.

We are very pleased to have 110 participants from 18 countries to attend the Workshop. We are grateful to the members of the Program Committee, especially to John Luck and Peter Shelus for their many suggestions to the Workshop agenda. Many thanks to Mike Pearlman, John Degnan, Ben Greene, Hiroo Kunimori and all session chairpersons for their valuable supports to the organization of the Workshop.

The agenda of the Workshop is included in the Proceedings. Comparing with the content, you may find some changes: some authors have not submitted their papers, while a few authors prefer to give some new papers. We collect all those good papers in the Proceedings.

A special thank go to the Astronomical Committee, Chinese Academy of Sciences and Chinese Astronomical Society for their financial supports to the Workshop.

Thanks also go to many colleagues of mine for their hard work during the Workshop and the preparation of the Proceedings publication, especially to Chen Wanzhen, Tan Detong, Xiao Chikun, Zhang Zhongping and Liu Nailing.

YANG Fumin

Chairman

10th International Workshop on Laser Ranging Instrumentation

# List of Participants of 10th Laser Workshop

Shanghai, November 11-15, 1996

Al-ghamdi, Attieh A  
Institute of Astronomy and Geophysics  
SALRO  
P. O. BOX 6086  
Riyadh 11442  
SAUDI ARABIA  
Tel: 966-1-4813325  
Fax: 966-1-4813523  
E-mail: alghamdi@kacst.edu.sa

Araki, Shintaro  
S & A, Ltd.  
8-26-2 Konandai, Konan-ku,  
Yokohama 244  
JAPAN  
Fax: 81-45-881-7364

Balodis, Janis  
Institute for Geodesy and Geoinformation  
University of Latvia  
19 Boulevard Rainis, LV-1586 Riga  
LATVIA  
E-mail: slr\_jb@laima.acad.latnet.lv

Banni, Aldo  
Cagliari Astronomica Station  
Loc.Poggio dei Pini, Strada 54  
09012 Capoterra  
ITALY  
Tel: 39-70-725246  
Fax: 39-70-725425  
E-mail: banni@ca.astro.it

Beutler, Gerhard  
Astronomical Institute of Berne  
Sidlerstrasse 5  
CH-3012 Berne  
SWITZERLAND  
Tel: 41-31-6318591  
Fax: 44-31-6313869  
E-mail: gurtner@aiub.unibe.ch

Bock, Olivier  
I.G.N (National Geographic Institute)  
2 avenue Pasteur  
94160 Saint Mandé,  
FRANCE  
Tel: 331-43988392  
Fax: 331-43988581  
E-mail: bock@icare.ign.fr

Burmistrov, Vladimir  
Russian Institute of Space Device Eng.  
53 Aviamotornaya Street  
Moscow 111024  
RUSSIA  
E-mail: natali@ricimi.msk.su

Carter, David  
NASA/ Goddard Space Flight Center  
Code 921.0  
Greenbelt, MD 20771

USA  
Tel: 301-286-6319  
Fax: 301-286-0213  
E-mail: dcarter@eib1.gsfc.nasa.gov

Chen, Wanzhen  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: yangfm@center.shao.ac.cn

Chen, Zongping  
Geo Forschungs Zentrum (GFZ)  
Telegrafenberg A 17  
D-14473, Potsdam  
GERMANY  
E-mail: prd@dfd.dlr.de

Dahl, Leigh  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Decker, Winfield  
AlliedSignal Technical Services Corp.  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3993  
Fax: 301-805-3974  
E-mail: DeckerW@thorin.atsc.allied.com

Degnan, John J.  
NASA/Goddard Space Flight Center  
Crustal Dynamic Project Center  
Code 920.1  
Greenbelt, MD 20771-0001  
USA  
Tel: 301-286-8470  
Fax: 301-286-0213  
E-mail: degnan@cddis.gsfc.nasa.gov

Dunn, Peter  
Hughes STX Corporation  
Suite 400,  
7701 Greenbelt Road  
Greenbelt, MD 20770  
USA  
E-mail: pdunn@stx.com

Eanes, Richard  
Center for Space Research  
University of Texas at Austin  
3925 W. Braker Ln, Suite 200  
Austin, Texas 78759-5321  
USA

Tel: 512-471-4267  
Fax: 512-471-3570  
E-mail: eanes@utcsr.ac.utexas.edu

Elphick, Mark  
Orroral Observatory  
Auslig, PO Box 2,  
Belconnen ACT 2616,  
AUSTRALIA  
Tel: 61 6 2357111  
Fax: 61 6 2357103  
E-mail: markelphic@auslig.gov.au

Fan, Chunbo  
Changchun Satellite Observatory  
Chinese Academy of Sciences  
Jing Yue Tan, Changchun 130117  
CHINA  
Tel: 86-431-4511337  
Fax: 86-431-4513550  
E-mail: zhxh@mail.jlu.edu.cn.

Fujita, Masayuki  
Ocean Research Laboratory  
Hydrographic Department of Japan  
5-3-1 Tsukiji, Chuo-ku, Tokyo 104  
JAPAN  
Tel: 81-3-3541-4387  
Fax: 81-3-3541-4387  
E-mail: mfujii@cue.jhd.go.jp

Gaignebet, Jean  
OCA/CERGA  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
Fax: 33-93-40-53-33  
E-mail: gaignebet@obs-azur.fr

Gao, Yue  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Glotov, Vladimir  
Russian Space Agency,  
Mission Control Center  
RUSSIA  
Tel: 7-095-513-44-75  
Fax: 7-095-274-00-25  
E-mail: navserv@mcc.rsa.ru

Gong, Xiangdong  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618

E-mail: yangfm@center.shao.ac.cn

Greene, Ben  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Greene, Lyn  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Gurtner, Werner  
Astronomical Institute, University of Berne  
Sidlerstrasse 5  
CH-3012 Berne  
SWITZERLAND  
Tel: 41-31-6318591  
Fax: 41-31-6313869  
E-mail: gurtner@aiub.unibe.ch

Hamal, Karel  
Czech Technical University  
Brehova 7,  
115 19 Prague 1  
CZECH REPUBLIC  
Tel: 42-2-85762246  
Fax: 42-2-85762252  
E-mail: prochazk@mbox.cesnet.cz

Hatat, Jean-Louis  
OCA/CERGA, LLR Station  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
E-mail: hatat@obs-azur.fr

He, Huijuan  
Shanghai Institute of Optics and Fine  
Mechanics,  
Chinese Academy of Sciences  
PO Box 8211, Shanghai  
CHINA  
Tel: 86-21-59534890  
Fax: 86-21-59528885

Huang, Chengli  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: jwj@center.shao.ac.cn

Huang, Li  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191

Fax: 86-21-64384618  
E-mail: yangfm@center.shao.ac.cn

Husson, Van  
AlliedSignal Technical Services Corporation  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3981  
Fax: 301-805-3974  
E-mail: HussonV@thorin.atsc.allied.com

Jackson, Suzanne  
Orroral Observatory  
Auslig, PO Box 2,  
Belconnen ACT 2616,  
AUSTRALIA  
Tel: 61 6 2357111  
Fax: 61 6 2357103  
E-mail: suzyj@auslig.gov.au

Jiang, Hu  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: jh@center.shao.ac.cn

Jin, Honglin  
Changchun Satellite Observatory  
Chinese Academy of Sciences  
Jing Yue Tan, Changchun 130117  
CHINA  
Tel: 86-431-4511337  
Fax: 86-431-4513550  
E-mail: zhxx@mail.jlu.edu.cn

Jin, Wenjing  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: jwj@center.shao.ac.cn

Kirchner, Georg  
Austrian Academy of Sciences  
Observatory Lustbuhel  
Lustbuhelstr. 46  
A-8042 Graz  
AUSTRIA  
Tel: 43-316-4673-51  
Fax: 43-316-462678  
E-mail: kirchner@flubiw01.tu-graz.ac.at

Koidl, Franz  
Austrian Academy of Sciences  
Observatory Lustbuhel  
Lustbuhelstr. 46  
A-8042 Graz  
AUSTRIA  
Tel: 43-316-4673-51  
Fax: 43-316-462678  
E-mail: kirchner@flubiw01.tu-graz.ac.at

Kokurin, Yuri  
Lebedev Physical Institute  
Leninsky Prospect 53  
Moscow 117924  
RUSSIA  
Tel: 007-095-132-0729  
Fax: 007-095-938-2551  
E-mail: kokurin@fian.crimea.ua

Kolbl, Josef  
Electro Optic Systems GmbH  
Hermann-Gcib-Strasse 18  
D-93053 Regensburg  
GERMANY  
Fax: 49 9 41 781222

Kunimori, Hiroo  
Communications Research Laboratory  
4-2-1 Nukuikita  
Koganei, Tokyo 184  
JAPAN  
Tel: 81-423-27-7565  
Fax: 81-423-27-6664  
E-mail: kuni@crl.go.jp

Liang, Ersheng  
Changchun Satellite Observatory  
Chinese Academy of Sciences  
Jing Yue Tan, Changchun 130117  
CHINA  
Tel: 86-0431-4511337  
Fax: 86-0431-4513550  
E-mail: zhxx@mail.jlu.edu.cn

Lin, Qinchang  
Guangzhou Satellite Station  
Chinese Academy of Sciences,  
Wushan, Guangzhou, 510640  
CHINA  
Tel: 86-020-87707002  
E-mail: gzgsos@public.guangzhou.gd.cn

Liu, Nailong  
Chinese Academy of Surveying and  
Mapping  
16 Beitaping Rd, Beijing 100039  
CHINA  
Tel: 86-010-68212277-255  
Fax: 86-010-68218654  
E-mail: wangtq@sun.ihep.ac.cn

Liu, Zhi  
Changchun Satellite Observatory  
Chinese Academy of Sciences  
Jing Yue Tan, Changchun 130117  
CHINA  
Tel: 86-0431-4511337  
Fax: 86-0431-4513550  
E-mail: zhxx@mail.jlu.edu.cn

Luceri, Vincenza  
Nuova Telespazio S.p.A.  
Centro di Geodesia Spaziale  
PO Box 155  
75100 Matera  
ITALY

Tel: 39-835-377231  
Fax: 39-835-334951  
E-mail: luceri@asimt0.mt.asi.it

Luck, John  
Orroral Observatory  
Auslig  
PO Box 2, Belconnen ACT 2616,  
AUSTRALIA  
Tel: 61 6 235-7111  
Fax: 61 6 235-7103  
E-mail: johnluck@auslig.gov.au  
orroral@auslig.gov.au

Maberry, Michael  
Observatory Foreman  
Lure Observatory, University of Hawaii  
PO Box 209  
Kula, Hawaii 96790  
USA  
E-mail: mike@lure.ifa.hawaii.edu

Mangin, Jean  
OCA/CERGA, LLR Station  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
Fax: 33-93 40 53 33  
E-mail: mangin@obs-azur.fr

Maurice, Laplanche  
OCA/CERGA  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
Fax: 33-93 40 53 33

Mcgarry, Jan  
NASA/ Goddard Space Flight Center  
Crustal Dynamic Project Center  
Code 920.1, NASA  
Greenbelt, MD 20771-0001  
USA  
Tel: 01-301-286-5020  
Fax: 01-301-286-0213  
E-mail: mcgarry@cddis.gsfc.nasa.gov

Moore, Christopher  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Morozov, Sergey  
Space system Control Office  
Russian Space Agency  
42, Schepkin st.  
Moscow 129090  
RUSSIA  
Tel: 095 975 4585  
Fax: 095 251 8702

Murata, Masaaki  
National Aerospace Laboratory  
7-44-1 Jindaiji-Higashi

Chifu, Tokyo 182  
JAPAN  
Tel: 81-422-47-5911(ext.2527)  
Fax: 81-422-42-0566  
E-mail: murata@nal.go.jp

Murdoch, Alan  
AlliedSignal Technical Services Corp.  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3993  
Fax: 301-805-3974  
E-mail: MurdocA@thorin.atsc.allied.com

Mureddu, Leonardo  
Cagliari Astronomica Station  
Loc.Poggio dei Pini, Strada 54  
09012 Capoterra  
ITALY  
Tel: 39-70-725246  
Fax: 39-70-725425  
E-mail: mureddu@ca.astro.it

Neubert, Reinhart  
Geo Forschungs Zentrum (GFZ)  
Telegrafenberg A 17  
D-14473, Potsdam  
GERMANY  
Tel: 49-331-288-1153  
Fax: 49-331-288-1111  
E-mail: neub@gfz-potsdam.de

O'Gara, Daniel  
Project Manager  
Lure Observatory, University of Hawaii  
PO Box 209  
Kula, Hawaii 96790  
USA  
Tel: 808 878 1217  
Fax: 808 878 2852  
E-mail: ogara@lure.ifa.hawaii.edu

Officerski, Jacek W.  
Delft University of Technology  
Faculty of Geodetic Engineering  
Satellite Geodesy Group  
Thijsseweg 11  
2629 JA DELFT  
THE NETHERLANDS  
Tel: 31-152785277  
Fax: 31-152783711  
E-mail: joffi@geo.tudelft.nl

Otsubo, Toshimichi  
Communications Research Laboratory  
4-2-1 Nukui-kita,  
Koganei, Tokyo 184  
JAPAN  
Tel:  
Fax: 81-423-27-7933  
E-mail: otsubo@crl.go.jp

Paradiso, Michele  
Nuova Telespazio S.p.A.  
Centro di Geodesia Spaziale  
PO Box 155

75100 Materra  
ITALY  
Tel: 39-835-377290  
Fax: 39-835-334951  
E-mail: paradiso@asimt0.mt.asi.it

Paris, J.  
OCA/CERGA  
Avenue Copernic  
F 06130-Grasse  
FRANCE

Parkhomenko, Natalia  
Russian Institute of Space Device  
Engineering  
53 Aviamotornaya Street  
Moscow 111024  
E-mail: natali@ricimi.msk.su  
RUSSIA

Paunonen, Matti  
Finnish Geodetic Institute  
Geodeetinrinne 2  
FIN - 02431 Masala  
FINLAND  
Tel: 358-9-264994  
Fax: 358-9-264995  
E-mail: geodeet@csc.fi

Pavlis, Erricos  
NASA/Goddard Space Flight Center  
Space Geodesy Branch,  
Code 926  
Greenbelt, MD 20771-0001  
USA  
Tel: 301-286-4880  
Fax: 301-286-1760  
E-mail: epavlis@helmert.gsfc.nasa.gov

Pearlman, Michael R  
Harvard-Smithsonian  
Center for Astrophysics  
60 Garden Street  
Cambridge, MA 02138  
USA  
Tel: 617-495-7481  
Fax: 617-495-7105  
E-mail: pearlman@cfa.harvard.edu

Pen, Bibo  
Institute of Geodesy and Geophysics,  
Chinese Academy of Sciences  
54 Xudong Rd, Wuhan 430077  
CHINA  
Tel: 86-27-6813841  
Fax: 86-27-6813841  
E-mail: bobby@asch.whigg.ac.cn

Pham Van, Jacqueline  
OCA/CERGA, LLR Station  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
Fax: 33-93 40 53 33  
E-mail: phamvan@ocar01.obs-azur.fr

Pierron, Francis  
OCA/CERGA  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
E-mail: pierron@obs-azur.fr

Pop, Eugen  
Astronomical Institute of Berne  
Sidlerstrasse 5  
CH-3012 Berne  
SWITZERLAND  
Tel: 41-31-6318591  
Fax: 44-31-6313869  
E-mail: gurtner@aiub.unibe.ch

Prochazka, Ivan  
Czech Technical University  
Brehova 7  
115 19 Prague 1  
CZECH REPUBLIC  
Tel: 42-2-85762246  
Fax: 42-2-85762252  
E-mail: prochazk@mbox.cesnet.cz

Qu, Feng  
Chinese Academy of Surveying and  
Mapping  
16 Beitaping Rd, Beijing 100039  
CHINA  
Tel: 86-10-68212277-255  
Fax: 86-10-68218654  
E-mail: wangtq@sun.ihep.ac.cn

Schiavone, Franco  
Nuova Telespazio S.p.A.  
Centro di Geodesia Spaziale  
PO Box 155  
75100 Matera  
ITALY  
Tel: 39-835-377230  
Fax: 39-835-334951  
E-mail: laser@asimt0.mt.asi.it

Schillak, Stanislaw  
Space Research Centre  
Polish Academy of Sciences  
Astrogeodynamical Observatory  
Borowiec, ul. Drapalka 4  
Kornik ,62-035  
POLAND  
Tel: 48-61-170187  
Fax: 48-61-170219  
E-mail: sch@cbk.poznan.pl  
laser@cbk.poznan.pl

Schreiber, Ulrich  
Technische Universität Muenchen  
Fundamentalstation Wettzell  
D-93444 Koetzing  
GERMANY  
Tel: 49- 9941 603-113  
Fax: 49- 9941 603-222  
E-mail: schreiber@wettzell.ifag.de

Seemueller, Wolfgang  
DGFI, Abt.I

Marstallplatz 8  
D-80539 Muenchen  
GERMANY  
Tel: 49- 9941 603-113  
Fax: 49- 9941 603-222  
E-mail: seemueller@dgfi.badw-  
muenchen.de

Selden, Mike  
AlliedSignal Technical Services Corp.  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3993  
Fax: 301-805-3974  
E-mail: SeldenM@thorin.atssc.allied.com

Shargorodski, Vladimir  
Secretary of Russian Representation of  
WPLTN  
53 Aviamotornaya Street  
Moscow 111250  
RUSSIA  
E-mail: vladimir@vshar.msk.ru

Shargorodsky, Victor  
Russian Institute of Space Device Eng.  
53 Aviamotornaya Street  
Moscow 111250  
RUSSIA  
Tel: 095 273 3344  
Fax: 095 273 4535  
E-mail: natali@ricimi.msk.su

Shelus, Peter  
McDonald Observatory  
Dept of Astronomy  
University of Texas-Austin  
Austin TX 78712  
USA  
E-mail: pjs@astro.as.utexas.edu

Sinclair, Andrew  
Royal Greenwich Observatory  
Madingley Road  
Cambridge CB3 0EZ  
UK  
Fax: 44-1223-374700  
E-mail: ats@ast.cam.ac.uk

Sperber, Peter  
Institute for Applied Geodesy  
Fundamentalstation Wettzell  
D-93444 Koetzing  
GERMANY  
Tel: 49 9941 603205  
Fax: 49 9941 603222  
E-mail: sperber@wettzell.ifag.de

Sun, Zhanao  
Shanghai Institute of Optics and Fine  
Mechanics, Chinese Academy of Sciences  
PO Box 8211, Shanghai  
CHINA  
Tel: 86-021-59534890  
Fax: 86-021-59528885

Suzaki, Yasuji  
Telecommunications Division Hitachi, Ltd.  
216 Totsuka-cho, Totsuka-ku  
Yokohama 244  
JAPAN  
Fax: 81-45-881-7364

Tan, Detong  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: tdt@center.shao.ac.cn

Tawadros, Maher Y.  
Helwan Institute of Astronomy and  
Geophysics,  
el Marsed street, Helwan, Cairo  
EGYPT  
Tel: 002 02 782683  
Fax: 002 02 782683  
E-mail: satellite2@frcu.eun.eg

Titterton, Paul  
EOO, Inc  
269 North Mathilda Ave  
P.O. Box 60339  
Sunnyvale, CA 94086  
USA  
Tel: 408-738-5390  
Fax: 408-738-5399  
E-mail: eooinc@aol.com

Torre, Jean-Marie  
OCA/CERGA, LLR Station  
Avenue Copernic  
F 06130-Grasse  
FRANCE  
E-mail: torre@ocar-azur.fr

Van der Kraan, Rien  
TNO Institute of Applied Physics(TPD)  
PO Box 155 , 2600 AD Delft  
THE NETHERLANDS  
Tel: 31 15 2692000  
Fax: 31 15 2692111

Van Loon, Danny  
Delft University of Technology  
Kootwijk Observatory for Satellite Geodesy  
Thijsseweg 11  
2629 JA DELFT  
THE NETHERLANDS  
Tel: 31 15 2788137  
Fax: 31-15 2782526  
E-mail: vanloon@geod.tudelft.nl

Varghese, Tom  
AlliedSignal Technical Services Corp.  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3993  
Fax: 301-805-3974  
E-mail: VargheT@thorin.atssc.allied.com

Vassilev, Vladimir  
Russian Institute of Space Device  
Engineering  
53 Aviamotornaya Street  
Moscow 111024  
RUSSIA  
Tel: 095 2732911  
E-mail: natali@ricim.msk.su

Visser, Huib  
TNO Institute of Applied Physics(TPD)  
PO Box 155, 2600 AD Delft  
THE NETHERLANDS  
Tel: 31 15 2692000  
Fax: 31 15 2692111

Wang, Yanjie  
Electro Optic Systems Pty Limited  
55A Monaro St. Queanbeyan NSW 2620  
AUSTRALIA  
Tel: 61 6 299 2470  
Fax: 61 6 299 7687  
E-mail: eos@netinfo.com.au

Wang, Tanqiang  
Chinese Academy of Surveying and  
Mapping  
16 Beitaping Rd, Beijing 100039  
CHINA  
Tel: 86-10-68212277-255  
Fax: 86-10-68218654  
E-mail: wangtq@sun.ihep.ac.cn

Wang, Wu  
Yunnan Observatory,  
Chinese Academy of Sciences  
Kunming 650011  
CHINA  
Tel: 86-871-3911347  
Fax: 86-871-3911845  
E-mail: yozsx@public.km.yn.cn

West, Owen  
School of Surveying and Land Information  
Curtin University of Technology  
GPO Box U 1987  
Perth 6001  
West AUSTRALIA  
Fax: 61 9 257 1892

Wetzel, Scott  
AlliedSignal Technical Services Corp.  
7515 Mission Drive,  
Lanham, MD 20706  
USA  
Tel: 301-805-3993  
Fax: 301-805-3974  
E-mail: WetzelS@thorin.atsc.allied.com

Wood, Roger  
NERC Satellite Laser Ranger Facility,  
Herstmonceux Castle Hailsham  
East Sussex BN27 1RP

UK  
Tel: 44 (01323) 833888  
Fax: 44 (01323) 833929  
E-mail: rw@gxvfrgo.ac.uk

Wu, Jie  
National University of Defense Technology  
303 Changsha, Hunan province, 410073  
CHINA  
Tel: 86-731-4516759

Xia, Zhizhong  
Institute of Seismology,  
State Seismological Bureau  
Xiao Hong Shan, Wuhan 430071  
CHINA  
Tel: 86-27-7863456  
Fax: 86-27-7884662  
E-mail: hbwh@public.sta.net.cn

Xiao, Chikun  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: yangfin@center.shao.ac.cn

Xiong, Yaoheng  
Yunnan Observatory,  
Chinese Academy of Sciences  
Kunming 650011  
CHINA  
Tel: 86-871-3911347  
Fax: 86-871-3911845  
E-mail: yozsx@public.km.yn.cn

Xu, Yongping  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: yangfin@center.shao.ac.cn

Yamaguchi, Tetsuro  
Denoh System, Ltd.  
202 SunCourt Totsuka  
167-1 Totsuka-Cho, Totsuka-ku  
Yokohama 244  
JAPAN  
Fax: 81-45-865-7364?

Yan, Haojian  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: yhj@center.shao.ac.cn

Yang, Fumin  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: yangfm@center.shao.ac.cn

Ye, Shuhua  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: ysh@center.shao.ac.cn

Zhang, Yufeng  
Xi'an Research Institute of Surveying  
and Mapping  
1 Middle Yanta Road, Xi'an 710054  
CHINA  
Tel: 86-29-5534996  
Fax: 86-29-5525310

Zhang, Zhongping  
Shanghai Observatory  
Chinese Academy of Sciences  
80 Nandan Rd, Shanghai 200030  
CHINA  
Tel: 86-21-64386191  
Fax: 86-21-64384618  
E-mail: zzp@center.shao.ac.cn

Zhao, You  
Changchun Satellite Observatory  
Chinese Academy of Sciences  
Jing Yue Tan, Changchun 130117  
CHINA  
Tel: 86-431-4511337  
Fax: 85-431-4513550  
E-mail: zhxh@mail.jlu.edu.cn



# Workshop Agenda

## TENTH INTERNATIONAL WORKSHOP ON LASER RANGING INSTRUMENTATION

**Sunday, November 10, 1996**

**9:00-22:00 Registration/Orientation (Hope Hotel)**

**21:30-23:30 Program Committee/Session Chairperson Meeting**

**Co-Chairpersons: Yang Fumin, Shanghai Observatory  
Michael Pearlman, Harvard/SAO**

**Monday, November 11**

**9:00- 9:40 Welcome and Opening**

**9:40-12:00 Scientific Achievements and Applications**

**Chairperson: Richard Eanes, UTX/CSR**

1. Application of SLR to Temporal Variations of the Gravity Field and Earth Orientation  
R. Eanes, UTX/CSR
2. Science from Lunar Laser Ranging  
P. Shelus, UTX/McDonald Observatory
3. Applications of Accurate SLR Station Positioning  
P. Dunn for the GSFC SLR Analysis Group
4. SLR Contributions to the Mean Gravity Field  
E. Pavlis for the GSFC/DMA Gravity Group
5. Analysis of Non-gravitational Forces on the Etalon Satellites from a 2.5-year Orbital Arc  
G. Appleby, RGO
6. Compact Laser Transponders for Interplanetary Ranging and Time Transfer  
J. Degnan, NASA/GSFC
7. A Wide Angle Airborne Laser Ranging System for Millimeter Accuracy Subsidence Measurements  
O. Bock, M. Kasser (ESGT), Ch. Thom (IGN), France
8. Lidar System for Emergency Detection and Environmental Monitoring of the City Air  
E. Andruschak, V. Vassiliev, V. Shargorodsky, A. Kozyrev, RISDE, Russia
9. Proposition for a New SLR Methodology Using CW or Long Pulse Lasers (poster)  
M. Kasser (ESGT), Ch. Thom (IGN), France
10. Short Message " Invitation to SLR Stations for Work with a Satellite Equipped with Retroreflectors and GPS/GLONASS Receiver" Which Will Be Launched in the Near Future. (poster)  
V. Vassiliev, V. Shargorodsky, RISDE, Russia
11. Preliminary Report on ADEOS/RIS Laser Tracking Experiments (poster)  
H. Kunimori, T. Goto, H. Nojiri CRL, M. Sawabe, N. Ogawa, M. Maeda NASDA, Japan

- 13:30-15:30 Station Performance Evaluation**  
**Chairperson: Michael Pearlman, Harvard/SAO**
- 15:30-15:45 Break**
- 15:45-17:30 Station Performance Evaluation (continued)**  
**Chairperson: Michael Pearlman, Harvard/SAO**
- 17:45-19:00 Buffet reception**
- 19:10-22:00 Huangpu River Cruise (for volunteers)**

**Tuesday, November 12**

**8:30-10:00 New Fixed Stations**

**Chairperson: Hiroo Kunimori, CRL, Japan**

1. The New Laser and Astrometric Telescope in Zimmerwald  
 W. Gurtner, E. Pop, J. Utzinger, T. Schildknecht, Astronomical Institute, University of Berne, Switzerland, J. Barbe, G.I.E. Telas, Cannes, France
2. The Use of High-Precision Absolute Optic-Electronic Axis-Angular Encoder in SLR System, Fan Cunbo, et al Changchun Observatory, China
3. The Matera Laser Ranging Observatory: Current Status  
 Giuseppe Bianco (ASI, Center for Space Geodesy, Matera, Italy)  
 Michael D. Selden ATSC, USA
4. Keystone SLR System  
 Hiroo Kunimori, Communications Research Laboratory,  
 and Ben Greene, Electro Optic Systems
5. Laser Ranging From The Naval Research Laboratory at the USAF Starfire Optical Range: an Update  
 G. Charmaine Gilbreath, U. S. Naval Research Laboratory and Mark A. Davis,  
 Alan Murdoch, Scott L. Wetzel, AlliedSignal Technical Services Corporation
6. Upgrading the SLR Station Katsively (poster)  
 V.Ignatenko, L.Kokurin, F.Lobanov, N.Sukhanovski, N.Triapitsin  
 Lebedev Physical Institute, Russia
7. Status Report of Borowiec SLR, 1994-1996 (poster)  
 Stanislaw Schillak, J.Bartoszak, Space Research Center of Polish Academy of Sciences  
 Astrogeodynamical Observatory, Poland

**10:00-10:30 Break**

**10:30-12:00 New Mobile Stations**

**Chairperson: Ulrich Schreiber, Wettzell, Germany**

1. FTLRS: Report on the Corsica Campaign  
 F.Pierron, OCA/CERGA, France

6. A New Generation of Laser Ranging Satellite for Sub-Millimeter Ranging.  
B. Greene (EOS), V. Shargorodsky, M. Fujita, H. Kunimori.
7. The TiPS Mission, Past, Present and Future.  
S. Wetzel and 14 others, ATSC, USA
8. Variations in L1L2-Topex Bias from a Point of View of Spacecraft and Ground Systems  
Peter Dunn (Hughes STX), Tom Varghese(ATSC), USA
9. Brief Report of Calculation of Refined Mathematical Model of the Satellite WPLTN-1-fizeau (poster) V.Burmistrov,V.Shargorodsky,V.Vassiliev , N.Soyuzova  
Russian Institute of Space Device Engineering
10. Study of Retroreflectors with Two-spot Reflection Pattern at Sloped Light Incidence  
(poster) V.Burmistrov,V.Shargorodsky,V.Vassiliev,N.Soyuzova  
Russian Institute of Space Device Engineering
11. An Analysis of Polarization Effects in SLR Retroreflectors (poster)  
Kasser, ESGT/CNAM, France

**18:00-22:00 CSTG SLR/LLR Subcommittee General Meeting**

**Chairperson: John Degnan, NASA/GSFC**

**Wednesday, November 13**

**8:30-10:30 Detectors and Spectral Filters**

**Chairperson: Georg Kirchner, Graz, Austria**

1. The Test Performance of F4129f MCP-PMT at Changchun Station  
Liu Zhi, Zhao You, Zhang Xinghua, Fan Cunbo, China
2. (1) Increasing Satellite Laser Ranging System at Lure Observatory  
Mike Maberry, Lure Observatory, University of Hawaii, USA  
(2) How to Get GPS Data with a 400 mm (16 inch) Telescope.  
Zane, D. O'Gara Lure Observatory, University of Hawaii, USA
3. Advancements to Enhance Satellite Laser Ranging to Satellites with Low Optical Links  
Howard Donovan, Alan Murdoch, Mark Levy, Thomas Oldham, Brion Conklin, Bart C Clarke, R.Eichinger, Tom Varghese, (ATSC), John Degnan (NASA/GSFC)
4. Receiver and Timing Upgrades at NRL@SOR  
Alan Murdoch et.al ATSC, USA
5. SPAD Detectors for Ranging with Sub-mm Bias. (two speakers)
  - 1). Ivan Prochazka, K.Hamal Czech Technical University
  - 2). Ben Greene, EOS
6. SPAD Time Walk Compensation.  
G.Kirchner, F. Koidl, Observatory Lustbuhel, Austria

2. Report on the SALRO  
Attieh A Al Ghamdi, Saudi Arabia
3. TIGO Project : Concept, Status, Plans - First Results  
P.Sperber, A.Boer, R.Dassing, H.Hase, W.Schluter, H.Seeger, R.Kilger  
IfAG, Fundamentalstation Wettzell, Germany
4. A Transportable Laser Ranging System in China  
Xia Zhizhong, Institute of Seismology, Wuhan, China
5. Keystone Mobile Station  
B.Greene, EOS, Australia

**13:30-14:30 Lunar Laser Ranging**

**Chairperson: Peter Shelus, McDonald Observatory, USA**

1. Adaptive Ridge Regression: the Multicollinearity and Its Remedy in Lunar Laser Ranging  
Huang C.L., Jin W.J. and Xu Huaguan, Shanghai Observatory
2. Expected Results from the Analysis of LLR Data  
Ulrich Schreiber, J.Mueller, Wettzell, Germany
3. OCA/CERGA LLR: Status and Accuracy  
Jean-Francois Mangin, OCA/CERGA, LLR Station, France
4. The Impact of Technology on-LLR at MLRS  
Peter J. Shelus, Jerry R. Wiant, Randall L. Ricklefs, Arthur L. Whipple and Judit G. Rie, McDonald Observatory, University of Texas-Austin, USA
5. Millimetric Lunar Laser Ranging at OCA  
E. Samain, J.F. Mangin, J. D. Chabandie, OCA/CERGA, LLR Station, France
6. Compensation of a Laser Beam Propagation for the LLR  
Feng Hesheng, Xiong Yaoheng, Yunnan Observatory, China

**14:30-16:30 Target Design, Signature and Biases**

**Chairperson: Andrew Sinclair, RGO, UK**

1. Amplitude Corrections to Delay Measurements.  
J.McK. Luck, Orroal Observatory, Australia
2. Accuracy of Satellite Laser Ranging  
S.Schillak, Space Research Center of Polish Academy of Sciences  
Astrogeodynamical Observatory, Poland
3. Laser Reflector Design for the CHAMP Satellite  
R.Neubert, Geo Forschungs Zentrum(GFZ), Germany
4. Dependence of Ajisai's Center-of-Mass Correction on Laser Ranging System  
Toshimichi Otsubo, Jun Amagai and Hiroo Kunimori, CRL, Japan
5. Remote Sensing of Atmospheric Parameters  
U. Schreiber, Wettzell, Germany

**13:30-19:00 Buses leave for Sheshan station tour (SLR, VLBI, GPS, PRARE)**

**20:30-22:00 WPLTN Plenary Meeting (open)**

**Chairperson: Ben Greene, EOS, Australia**

**Thursday, November 14**

**8:30-10:00 Timing Devices and Calibration**

**Chairperson: John Luck, AUSLIG, Australia**

1. Instrumentation Development and Calibration for the Matera Laser Ranging Observatory  
M.Selden, C.Steggerda, R.Stringfellow, D.McClure, C.B.Clark, G.Bianco ATSC, USA
2. Multi-Counter Operation  
G.Kirchner, F.Koidl Austrian Academy of Sciences, Observatory Lustbuhel, Austria
3. Femtosecond Timing of Electronic Pulses  
B.Greene, L.Dahl, J.Kolbl, EOS, Australia
4. Timing System Aspects  
U.Schreiber, Wettzell, Germany
5. Short Distance Calibration  
G.Kirchner, F.Koidl Austrian Academy of Sciences, Observatory Lustbuhel, Austria
6. Portable SLR Calibration Standard  
I.Prochazka, K.Hamal (Czech Technical University), H.Kunimori, B.Greene

**10:00-10:30 Break**

**10:30-12:00 Multiwavelength Ranging/Streak Cameras**

**Chairperson: Jean Gaignebet, CERGA, France**

1. Streak Camera Limitations and New Timing Ideas  
J. Gaignebet, CERGA, France
2. An Electronic Streak Camera" with High Sensitivity and 15ps Resolution  
B.Greene, EOS
3. The Circular Scan- SC Experiment of the WLRS  
U.Schreiber, Wettzell, Germany
4. Water Vapor Correction of Two Color SLR  
R.Neubert, GFZ, Germany
5. Atmospheric Dispersion Monitoring Using 0.53 $\mu$ m and 1.54 $\mu$ m Satellite Laser Ranging.  
B.Greene (EOS), H.Kunimori, K.Hamal
6. Second Harmonic Generator Based T/R Switch  
K.Hamal (Czech Technical University), B.Greene

**13:30-15:30 System Automation and Operational Software**

**Chairperson: Jan McGarry, NASA/GSFC**

1. Deficiencies of the IRV Model for the GPS Satellites, and Some Possible Solutions ,

7. Large Aperture Germanium Detector Package for Picosecond Photon Counting in 0.5 to 1.6 um Range. Ivan Prochazka, K. Hamal, B. Greene, H. Kunimori
8. Testing Ge-APD's for Ranging Application in a Cryogenic Environment  
Ulrich Schreiber, Wetzell, Germany

**10:30-10:45 Break**

**10:45-11:30 Laser Technology Development**

**Chairperson: Karel Hamal, Czech Technical University**

1. Cr:LiSAF/Ti:Sapphire Based Solid State Laser System for Two Color SLR  
P.Sperber,.. IfAG, Wetzell, Germany
2. Lasers for kHz Satellite Ranging with Millimetre Precision and Accuracy  
Yue Gao, Ben Greene, Yanjie Wang, EOS
3. Optimal Design of Passively Q-switched Microlaser Transmitters for SLR  
J.J. Deghan, NASA/ GSFC
4. Eyesafe Raman Lasers  
K.Hamal,.. Czech Technical University
5. A Compact Modified SFUR Passively Mode-locked Nd: YAG Laser for SLR  
Sun Zhan'ao, Yang Xiangchun, Zhu Xiaolei, Wu Zhaoqing  
Shanghai Institute of Optics and Fine Mechanics  
Yang Fumin, Chen Wanzhen and Xiao Chikun, Shanghai Observatory

**11:30-12:30 Eyesafe Systems**

**Chairperson: Ivan Prochazka, Czech Technical University**

1. Short Review on Eyesafe SLR Techniques  
B.Greene,.. EOS
2. Integration of SLR Radar into the Geophysical Laboratory Environment  
Tom Varghese, Roger Allshouse, Howard Donovan, Don Patterson, Rich Savaal, Alan Murdoch, ATSC
3. SLR2000: an Inexpensive, Fully Automated, Eyesafe Satellite Laser Ranging System  
J.Degnan,.. NASA/GSFC
4. Correlation Processing Approach for Eyesafe SLR2000  
P.J.Titterton,.. EOO Inc, USA
5. SLR2000 Performance Simulations  
J.McGarry, NASA/GSFC
6. Eyesafe Satellite Laser Ranging Using Raman Shifter Nd:YAG Laser  
B.Greene,.. EOS
7. Integration of SLR Radar into the Geophysical Laboratory Environment  
Tom Varghese, Roger Allshouse, Howard Donovan, Don Patterson,  
Rich Savaal, Alan Murdoch (ATSC)

- Haojian Yan and Chugang Feng, Shanghai Observatory, China
3. The Question of Measuring Error Distribution in SLR Data  
Wu Jie, Li Zhengxin, Zhang Zhongping, Yang Fumin, Tan Detong  
Shanghai Observatory, China
  4. Full-rate vs. Normal Points: Two Ways of Managing SLR Data  
G. Bianco, R. Devoti, M. Fermi, V. Luceri, P. Rutigliano, C. Sciarretta  
Nuova Telespazio S.p.A. Centro di Geodesia Spaziale, Italy
  5. The Fast Computing the Spherical Harmonic Perturbation on Artificial Satellite and the Recurrence Equations of the Coefficients of the Earth's Gravity  
Lin Qinchang, Guangzhou Satellite Station, Chinese Academy of Sciences
  6. LRA Signature Assessment from TOPEX Precision Orbits.  
P.J. Dunn, T. Varghese and G.M. Appleby, RGO  
Hughes STX Corporation, USA
  7. Synchronous Satellite Laser Ranging for Millimeter Baselines.  
T. Herring (MIT), H. Kunimori(CRL) , B. Greene(EOS)
  8. Work Organization and Some Results of the Data Analysis on Satellite Laser Ranging at Russian Mission Control Center (poster)  
V.Glotov , V.Polyakov, V.Pochukaev, Mission Control Center, Russia
  9. Discussion over Orbit Determination of Satellite Ajisai  
Jiang Hu, Feng Chugang, Shanghai Observatory, China

19:00- Workshop Banquet

**Friday, November 15**

- 8:30-10:00 **Panel #1: Colocation between Techniques**  
Chairperson: Gerhard Beutler (Astronomical Institute of Berne)
- 10:00-10:30 **Break**
- 10:30-12:00 **Panel #2: Height Changes with mm Accuracy**  
Chairperson: Peter Dunn (Hughes STX )
- 13:30-15:00 **Workshop Summary and Resolutions**  
Chairperson: Ben Greene (EOS)
- 15:00-15:30 **Business Meeting**  
Chairperson: Ye Shuhua (Shanghai Observatory)
- 15:30-16:00 **Break**
- 16:00-18:00 **CSTG Steering Committee (by invitation)**  
Chairperson: John Degnan (NASA/GSFC)

A.T. Sinclair, Royal Greenwich Observatory.

2. The GFZ/D-PAF Orbit Prediction System with Emphasis on the Low Flyer GFZ-1  
Zongping Chen, GFZ/D-PAF
3. Matera Laser Ranging Observatory Software System  
Michael Selden, ATSC
4. X Window Based Graphical User Interface for a Laser Ranging Control System  
Jacek W. Offierski, Delft University of Technology
5. Real-time Correction of SLR Range Measurements for the Return Amplitude Induced Bias of the Multi-Channel Plate PMT/TC-454 DSD Discriminator Receive System,  
Dan O'Gara, University of Hawaii
6. Combined Digital Tracking System  
Ivan Prochazka, Czech Technical University
7. Automation of Borowiec SLR  
S. Schillak, Space Research Center of Polish Academy of Sciences
8. Upgrading the NASA SLR Network for the 21st Century  
David Carter, NASA/GSFC

**15:30-16:00 Break**

**16:00-16:30 System Automation and Operational Software (continued)**

**Chairperson: Jan McGarry**

9. NASA Single Operator Automation Project (SOAP)  
Winifred M. Decker, ATSC
10. Automated Quality Control of Data from the NASA SLR Network  
Van S Husson, ATSC
11. Automated and Remotely Operated SLR Systems  
Ben Greene, EOS
12. A Method to Improve the Precision of Low Orbit Satellite Prediction (poster)  
Lin Qinchang, Guangzhou Satellite Station, Chinese Academy of Sciences  
Yang Fumin, et al, Shanghai Observatory
13. RGO Predictions and Time Bias Functions  
Roger Wood, Royal Greenwich Observatory
14. Precaution for Thunder Storm in Beijing SLR station (poster)  
Wang Tanqiang, Liu Nailing, Beijing SLR Station, China

**16:30-18:00 Data Analysis and Models**

**Chairperson: Vincenza Luceri, Matera, Italy**

1. Analysis of HTLRS Data at Marine Fiducial Points in Japan  
Masayuki Fujita (Hydrographic Department of Japan)
2. New Mapping Function of the Tropospheric Refraction in SLR